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ATM-X

Air Traffic Management exploration

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Next Generation Air Transportation System (NextGen)

JPDO, 2007



Flight Planning

Flight Data

Aeronautical Information

Enterprise Services

Geospatial Information

Communication

Performance Metrics

Environment

Layered
Adaptive Security

Surveillance

Position, Navigation,
and Timing

Safety

Weather

Net Centric Infrastructure Services

Network-Enabled
Information Access

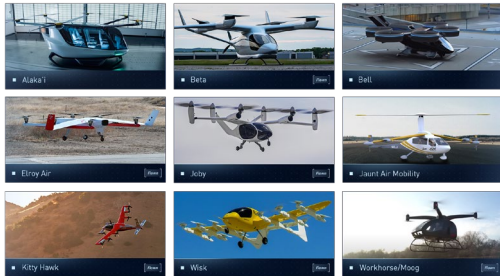
Questions/Comments:
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Updated June 2007, Version 2.0

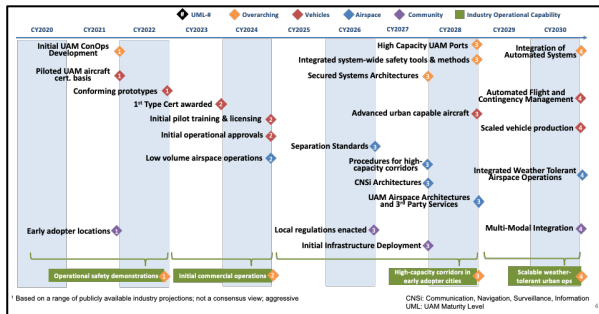


Motivation for Addressing New Entrants

Urban Air Mobility





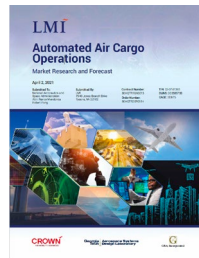
Strong Domestic eVTOL Industry Base



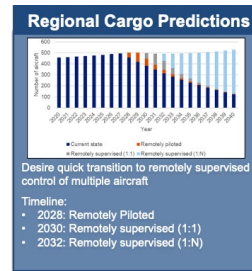
UAM Goals based on Aggressive Industry Timeline

Increasingly Autonomous Aircraft

Manufacturers	Operators
Natilus Orion Elroy Reliable Robotics Northrup Grumman Pipistrel Xwing Beta Volansi Bell Merlin	Amazon Atlas FedEx UPS  



2021 Market Study



Upper Class E

Manufacturers
AeroVironment
Airbus US
Aloft Research
Aurora/Boeing
Boom Supersonic
General Atomics
HAPS Mobile/AeroVironment
Lockheed Martin



ETM Workshop, Jul 2021

More Diverse Operations

Space
Launch
Operations

HALE Fixed-Wing

HALE
Balloon

- Emerging operators want to enter the airspace and fly their desired missions
- More operational flexibility is desired
- Increase the pace of NAS Modernization
- Consider controller workload

Large UAS

Commercial

Supersonics

General
Aviation

Regional

eVTOL UAM

sUAS

ATM-X Project Strategy

The background of the slide features a dark blue sky with a rocket launching from the bottom center, a satellite in the upper right, and a city map at the bottom with various flight paths and aircraft icons. A large blue rectangular box is overlaid on the center of the slide, containing the project strategy list.

- Develop Requirements for a Scalable Service-Oriented Architecture to Accelerate NAS Modernization
- Improve Operational Flexibility with the Development of User-Informed Airspace Management Services
- Collaborate with Diverse Range of Industry in NAS Modernization
- Increase the use of NAS Information powered by Advanced Technology

ATM-X Vision and Goal



Vision: Accelerate transformation to a digitally-integrated air transportation system that enables access and increases mobility for all users

Goal: Catalyze the community to provide an all-access, safe, and efficient airspace system through innovative solutions



A New Way Forward



- Industry is poised to invest and contribute to developing airspace management systems
 - Accelerating scaled operations for small UAS (UTM)
 - Collaborative airspace management system framework
 - Service based - faster to deploy, scalable, and extensible to new entrants
- Technological advances in non-aviation industries
 - Increased computing speeds
 - Cloud-based infrastructures
 - Faster communications systems and more data
 - AI/Machine Learning

ATM-X will leverage this convergence of industry involvement and technological advances with a new architecture to transform the NAS



ATM-X Phase 2 Project Organization

Air Traffic Management – eXploration

Project Support

Coordinator: Louise Ruszkowski
Lead Analyst: Warcquel Frieson
Center Analysts: Brenda McKay,
Meredith Irwin
Schedulers: Natalie Condon,
Donna Gilchrist

Project Office

Project Manager: William Chan
Deputy Proj. Mgr.: Shawn Engelland (acting)
Deputy Proj. Mgr. - Tech: Kurt Swieringa
Chief Engineer - Dr. Joey Rios

ARD Office

ARC APM: Lindsay Stevens
LARC APM: Dr. Taumi Daniels
GRC APM: Rafael Apaza

Sky for All (Vision 2045)

Lead: Shawn Engelland
Dpy Lead: Kurt Swieringa

Systems Engineering

Lead: Dr. James Chartres
Risk Mgr: Joshua Moody

Management approach governed by NPR 7120.8A

Sub-Projects

Digital Information Platform (DIP)

SPM: Mirna Johnson
DSPM: Dr. Gilbert Wu
TL: Raj Pai

UAM Airspace Management (UAM)

SPM: Kevin Witzberger
DSPM: Joe O'Brien
PE: Dr. Ian Levitt

Pathfinding for Airspace with Autonomous Vehicles (PAAV)

SPM: Arwa Aweiss
TL: Tod Lewis

Extensible Traffic Management (xTM)

SPM: Dr. Jaewoo Jung
TL: Dr. Min Xue

ATM-X Research Areas

SKY FOR ALL

Digital Information Platform

Open-architecture for advanced data-driven services for traditional operations and new entrants



Extensible Traffic Management

Collaborative distributed service-based ATM decision-making

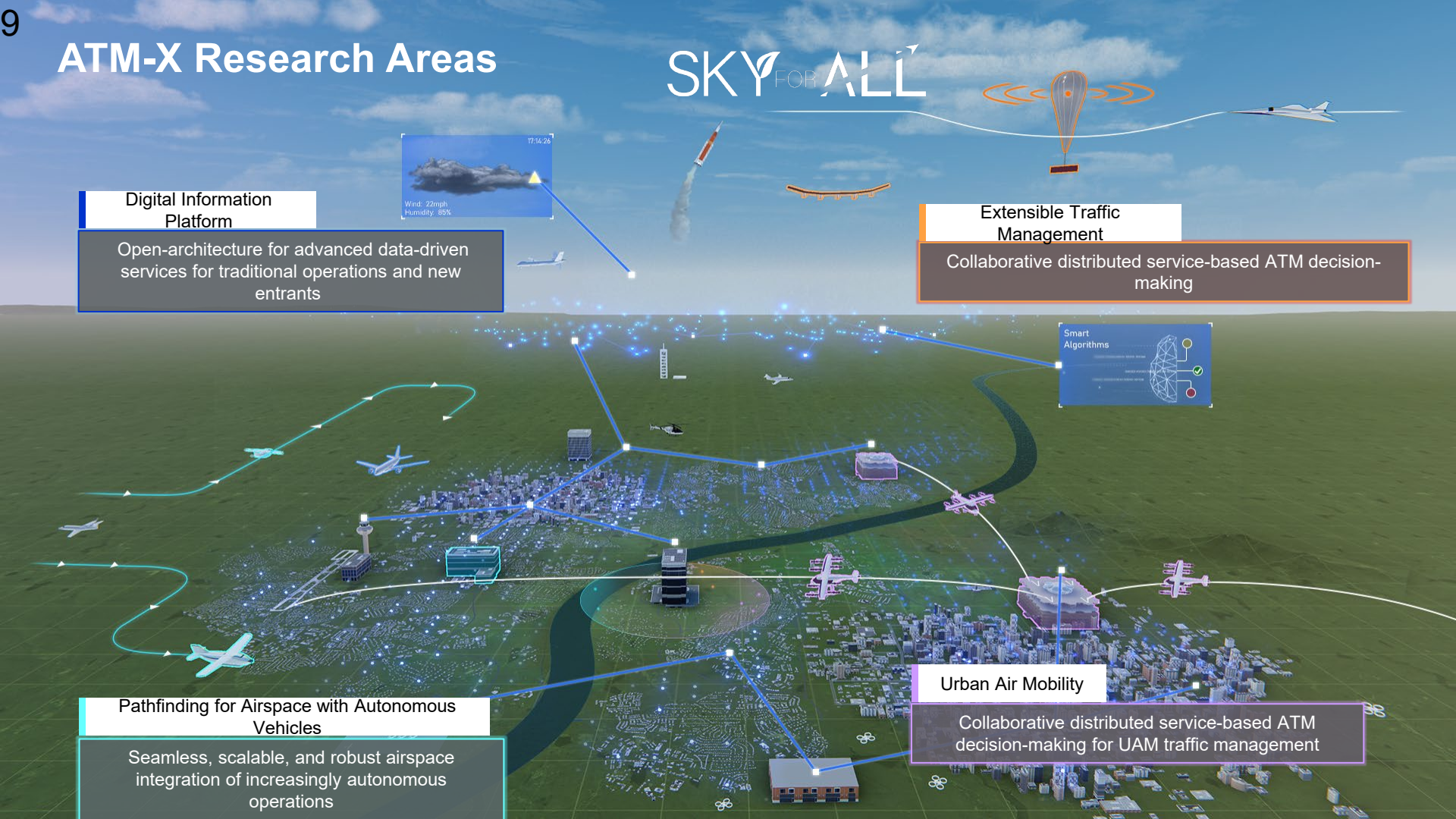


Pathfinding for Airspace with Autonomous Vehicles

Seamless, scalable, and robust airspace integration of increasingly autonomous operations

Urban Air Mobility

Collaborative distributed service-based ATM decision-making for UAM traffic management





Sky for All – FY21 Accomplishments

Coordinated across NASA and the FAA

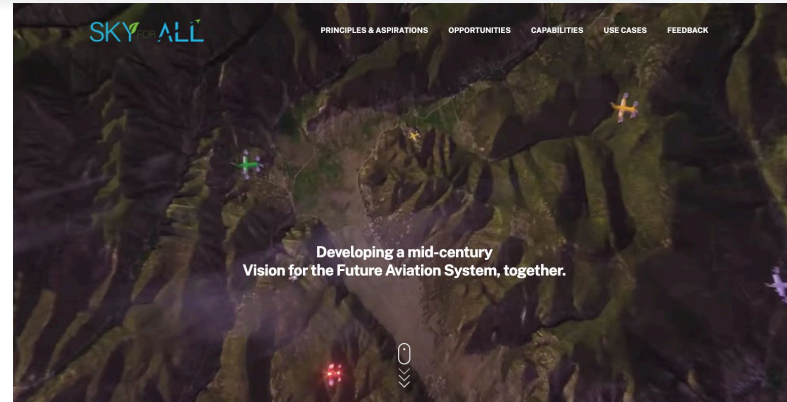
- ✓ Coordinated Sky for All communications plan with ARMD communications personnel
- ✓ Ensured alignment with the with FAA through bi-weekly NAS 2035 and Sky For All coordination meetings

Created video to share Sky For All aspirations

- ✓ Video shown at ATCA Technical Symposium (May 2021)
- ✓ Video updated for initial vision launch (Sep 2021)

Launched an interactive web portal to co-develop Sky For All vision with stakeholders

- ✓ Beta 1 version gathered contributions from ~70 NASA subject matter experts (Oct 2021)
- ✓ Beta 2 version will gather input from a broad ARMD audience (Oct 2021)





DIP FY21 Accomplishments



Gaining stakeholder interest through formulation of DIP and sustainable aviation services

- ✓ Gaining stakeholder involvement high-level objectives for a proposed demonstration series
- ✓ Addressing sustainable aviation using budget augmentation; notified in May 2021
- ✓ Leveraging AOSP investments working closely with ATD-2 to define demonstration series for FY22+

Building Partner Cohort and DIP vision

- ✓ Expanded scope of partners with a Request for Information (RFI) and assessed responses to identify promising industry stakeholders
- ✓ Laying foundation for Vision 2045 with ConOps development

Making Progress on Platform Design and Development

- ✓ Gathering industry support with using a completed design for DIP architecture
- ✓ Moving towards service-oriented architecture with a design to modularize digital-Surface Trajectory Based Operations (STBO) and NAS TMI service
- ✓ Concrete step towards easily accessible data by moving Fuser to Amazon Web Services Cloud



UAM FY21 Accomplishments



Defining a Stakeholder Informed Path Towards UML-4 Airspace

- ✓ Gained approval to proceed with sub-project execution
- ✓ Completed version 1 of UAM Airspace Roadmap
- ✓ Completed initial cyber-threat analysis approach using X4 as use-case in a series of Secure Airspace research deliverables

Ensuring Stakeholder Acceptance of Airspace Technology

- ✓ Selected X4 airspace partners (kick-off, experiment review) for National Campaign
- ✓ Selected Aura Networks as partner for potential comm tech (kick-off)
- ✓ Implemented UTM ASTM data exchange protocols for UAM architecture
- ✓ Delivered Provider of Services for UAM (PSU) for National Campaign Developmental Test flight activity
- ✓ X4 Safety Density Metric from SWS
- ✓ Representative eVTOL models from RVLT in X4
- ✓ Harmonizing conOps with potential demand studies for UAM in select US and German metro areas



PAAV FY21 Accomplishments



Focused Plan Towards Making an Impact for an Industry Need

- ✓ Autonomous cargo market study completed to confirm economic viability and clarify promising market segments (Apr 2021)
- ✓ Passed TC Tollgate review, establishing how ATM-X will address industry needs (Sep 2021)

Addressed industry identified barrier to inform NAS performance requirements

- ✓ Completed first PAAV HITL simulation evaluating impact of communication latency for unmanned aircraft

Gaining Community Support through stakeholder outreach and partnerships

- ✓ Participated with industry and the FAA in the development of the UAS Cargo ConOps that was published by RTCA in DO-304B, and used to inform gaps in current standards (Jun 2021)
- ✓ Released a request for information to industry and evaluated responses (Feb 2021)
- ✓ Actively pursuing multiple Space Act Agreements with industry

Building Community Informed ConOps that will describe progression higher levels of autonomy

- ✓ Two week-long tabletop exercises with subject matter experts to identify NAS integration challenges (Apr 2021, Jun 2021)
- ✓ Presented results from the first tabletop at the 2021 AIAA Aviation Conference (Aug 2021)
- ✓ Shortfall analysis report documenting NAS integration challenges in today's airspace system (Aug 2021)



xTM FY21 Accomplishments



Transforming the NAS by Maturing and Expanding xTM

- ✓ Matured UTM through supporting the FAA for the UTM Pilot Program 2.0 and associated standards development
- ✓ Established NASA and FAA leadership for ETM development via an RTT by bringing community together in a workshop and completing research

Ensuring xTM and ATM Integration for Harmonized Operations

- ✓ Established plan to ensure harmonization between xTM managed operations and conventional ATM operations through increasing the level of integration
- ✓ Obtained approval to proceed with xTM and ATM integration based Technical Challenge



ATM-X FY21 Summary



Jointly Defining A Future NAS with the FAA that is Aligned with FAA's InfoCentric NAS

Developing a Community Informed Platform for Digital Data as a Foundation for a Digitally Connected NAS to Improve Emerging and Current Airspace Operations

Enabling Mature Urban Air Mobility Operations with Early Industry Involvement Towards a Stakeholder Informed Architecture

Achieving Routine Access for Increasingly Autonomous Regional Cargo Operations with Stakeholder Collaborations

Accelerating the Transformation of the NAS through the Maturation and Expansion of UTM Framework for New Entrants

ATM-X Explores and Sets a New Paradigm for the Future NAS for All Airspace Users